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Type II Progress Report

Period September 1 to November 30, 1975

Earth Resources Evaluation for New Mexico by Landsat-2

(Follow-on Investigation #23370)

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Introduction

The objective of the study is to utilize Landsat data as well as supplementary photos and maps in conjunction with field investigation to provide information that will be useful in evaluating, developing and managing the natural resources of New Mexico. Emphasis will be placed on mineral resources, geologic structure, and landform surveys and on land-use survey and mapping.

Accomplishments

The statewide land-use map for New Mexico is in its final drafting stages and plans for publishing a full color 1:1,000,000 scale version have been made. The map itself was developed from Landsat color transparencies. Through the use of overlays, color tones and hues were delineated such that the resulting line map indicated various transitions of the vegetation and/or topography. Reliance on capable interpreters and an understanding of Landsat color products enabled the map to be compiled in less than 1 man month of time.

Through correlation of existing land cover information, a list of which can be found in Reference 1, and the satellite interpretation, a preliminary map was developed. This map was subject to change pending field investigations.

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Extensive field checking of the preliminary map was completed by mid-November. Interpreters identified contacts previously mapped and correlated these with the dominant vegetation and terrain. Where necessary, photographs were taken to supplement field notes.

Five major divisions of land cover are shown and each of these is further divided into dominant vegetation type, topographic relief, dominant economic use or other diagnostic conditions. Although these do not directly relate to the land-use classification established in USGS Circular 671, there will be a table of equivalents provided in the published version.

In late October two symposia were attended, the William T. Pecora Symposium sponsored jointly by the American Mining Congress and USGS, and the ASP-ACSM Fall Convention. These were held in Sioux Falls, South Dakota and Phoenix, Arizona, respectively. Both meetings provided direction for remote sensing activities in mineral exploration.

During the quarter we expanded mineral exploration using Landsat data from the Rio Grande Valley to the northwestern part of the state. The San Juan Basin and the Grants mineral belt will be examined. Digital data tapes will be used as a basis for studying relationships between the gas fields of the San Juan Basin and surface phenomena, such as soil alteration. Uranium deposit associations will also be of interest in the examination of surface alterations. Several techniques will be applied in the analysis, such as band ratioing and contrast stretching; but all will initially revolve around digital image enhancement. The scheduling of this activity with facilities at Los Alamos Scientific Labs is near completion. Literature has been reviewed and a number of contacts made in an effort to benefit from those persons performing related studies.

A study of the volcanic rocks in the Laguna and Bandera lava fields, Valencia County, New Mexico has been completed. The unit boundaries within the quaternary basalt flow and cinder cones had not been mapped on the geologic map for New Mexico (Dane & Bachman, 1965) so a study was performed to examine the feasibility of using Landsat imagery in their delineation. Several scenes were examined, the best of which was obtained April 7, 1974 (E-1623-17155). An examination of aerial photographs together with Landsat imagery revealed a striking difference between the older, more weathered Laguna flows and the younger Bandera flow. The Bandera flow erupted from several local

centers and primary flow features are preserved. Because lava tubes are present in the Bandera flow, the area is well known as a lunar analog. Several authors (Causey, 1971; Hatheway and Herring, 1970) have done detailed mapping of individual flow units and delineation of source areas within. Similar detailed mapping in the Laguna flows has not been performed.

Field investigation revealed the occurrence of ponderosa pine on basalt outcrops. The stands of ponderosa are limited to those areas where basalt is exposed or where a very thin veneer of wind-deposited soil is present on top of the basalt. There is almost a one-to-one relationship of ponderosa pine to basalt outcrops. The vegetation on areas where basalt is not outcropping consists of scattered pinon and juniper and abundant snakeweed. Flow boundaries are usually scarps from 3 to 6 meters high. These scarps are composed of blocky boulders of basalt and usually are vegetated with ponderosa pine.

Most of the Laguna flows are covered with a buff to red colored wind-deposited soil. The thickness of the soil ranges from almost nothing to more than one meter. Where present the soil completely obliterates surface features on the flows.

In general, the morphology of the Laguna flows is very subdued in comparison to the younger Bandera flow. Cinder cones have gentler slopes and generally are forested with ponderosa pine. Where the edge of a flow is a scarp composed of basalt boulders, ponderosa pine is usually present. Where outcrops are absent, no ponderosa is present.

The first analysis of the lava [illegible] was by visual inspection of the Landsat, Skylab and low altitude aerial photographs. Although there are striking differences on the photos, these differences could not be consistently correlated to the individually mapped units of the Bandera flow. Color composites proved most useful in discriminating flows but only in the more recent ones. A Bausch and Lomb Zoom Transfer Scope was used during the interpretation to provide image enlargement and correlation to several of the younger Bandera units previously mapped. Negatives (scale 1:1,000,000) were made from the black and white bands 5 and 7. These were then used on an I^2S closed-circuit TV color enhancing unit to enhance densities of the flow units. In addition, a 3-dimensional viewer was employed in the analysis.

In neither case, however, was a satisfactory discrimination of the Bandera fields noted, nor was a correlation with existing mapped units observed. Within the Laguna field there was no discrimination between the surface of the flow and the surrounding terrain. It is felt that delineation of lava fields within New Mexico cannot be made using the visual interpretation or visually enhanced photographic methods at the scale of the bulk processed imagery using the present spectral bands.

Significant Results

The statewide land-use map for New Mexico has been compiled, field checked and is in final stages of drafting for publication. Progress is being made in the mineral exploration studies of the Middle Rio Grande, San Juan Basin and the Grants Mineral Belt. Significant results from these activities are expected.

Publications and Talks

No papers have been published during this reporting period although several talks have been given to persons in the New Mexico State Planning Office, New Mexico Bureau of Mines and the University of New Mexico.

Landsat and Aircraft Imagery

A further revision of coordinate specifications requested during the last reporting period have been made. An order has been placed for statewide coverage with color prints using spring season dates as near to one another as possible. High altitude aerial coverage of the Socorro area previously returned for reproduction problems has been received.

Reference 1

I. References to accompany the land-use map of New Mexico

Gay, C.W. Jr., D.D. Dwyer, and R.E. Steger. 1970. "New Mexico Range Plants." New Mexico State University Extension Service Circular 374. 85pp.

Judd, B.E. 1962. "Principal Forage Plants of Southwestern Ranges." Rocky Mountain Forest and Range Experiment Station. Station Paper #69. 93pp.

Kuchler, A.W. 1964. Potential Natural Vegetation of the Conterminous United States. American Geographical Society Special Publication #36. Map scale 1:3,168,000.

State of New Mexico State Engineer and Interstate Stream Commission. 1968. New Mexico State Water Plan: Land-Use. Map scale approximately 1:400,000.

U.S. Department of Agriculture Soil Conservation Service. 1974. Vegetation Map of New Mexico. Map scale 1:1,333,333.

II. References employed in volcanic study

Baldwin, Brewster and W.R. Muehlberger. 1959. Geologic studies of Union County, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Bull. 73. 171pp.

Causey, J.D. 1971. Geology, geochemistry and lava tubes in Quaternary basalts Zuni Lava Field, Valencia Co., New Mexico. Unpublished Master's thesis, University of New Mexico. Albuquerque, New Mexico.

Dane, C.H. and G.O. Bachman. 1965. Geologic Map of New Mexico. USGS, NMIT, NM Bureau of Mines and Min. Res., UNM, Dept. of Geology.

Goddard, E.N. 1966. Geologic Map and sections of the Zuni Mountains fluorspar district, Valencia County, New Mexico. Miscellaneous Geologic Investigations, Map I-454.

Hatheway, A.W. and A.K. Herring. 1970. Bandera lava tubes of New Mexico and lunar implications: Commun. of the Lunar and Planetary Lab., Univ. Arizona, v. 8, no. 152, p. 299-327.

Nichols, R.L. 1946. McCartys basalt flow, Valencia County, New Mexico: Geol. Soc. Amer. Bull., v. 57, n. 11, p. 1049-1086.